Position Description

FACTOR I. - RESEARCH ASSIGNMENT

A. Research Organization

This position is in the Sound Branch of the Airplane Competency. The Sound Branch performs acoustics research to understand and control noise and its effects on aircraft, rotorcraft, and spacecraft structures, passengers, crew, and impacted community residents.

B. Personal Research

The incumbent conducts research to develop adaptive structures technology for a range of acoustic, vibration, and aerodynamic applications. In particular, shape memory alloys (SMA) offer great potential for such applications but require significant advances to be made on several fronts, including modeling and design, fabrication and testing, and application-specific concept development and implementation. Success in these endeavors will likely lead to additional, fruitful areas of study and unexpected applications. The funding for this effort is primarily from the Morphing Program, with additional support from the Quiet Aircraft Technology program. The incumbent plans, leads, and conducts applied research to advance the understanding and application of shape memory alloys for aerospace applications. To accomplish this assignment effectively, the incumbent has broad experience that enables the modeling, design, fabrication and testing of adaptive structures. This complex area of research requires knowledge and experience, which the incumbent has, of static and dynamic structural analysis and testing, materials modeling and characterization, and fabrication techniques

The central activity is the development and validation of models suitable for SMA and SMA hybrid composite structures. The incumbent applies this knowledge to projects aimed at particular applications and requires the incumbent to formulate and execute a research and design approach. This frequently involves the participation of other organizations both within and outside LaRC. Example projects include the modeling, design, fabrication, and testing of hybrid composite structures that adaptively stiffen in response to changing thermal conditions, thus yielding vibration suppression. Other projects are directed at changes in structural shape, with application to aerodynamic surfaces and noise control. If successful, such projects will provide one of the technology foundations necessary for morphing structures, thus enabling a broad

C. Team Leadership

The incumbent plans, coordinates and integrates a range of technologies and the associated researchers to develop and test adaptive structures. A typical project has a multi-disciplinary team consisting of researchers in metallic materials, test

structural testing, and composite fabrication specialists. The incumbent's primary role as team leader is to provide the technical leadership necessary to ensure that the component technologies result in a coherent and viable research approach. The incumbent leads the model development and validation efforts and provides the technical direction for the material characterization and fabrication work. This includes definition of performance goals, identification and assessment of limitations of component technologies, and overcoming problems associated

As team leader, the incumbent is responsible for developing, on an annual basis, work packages for incorporation into the Center's Morphing program. He also is responsible for evaluating progress, and reporting progress, as necessary, to the Program Manager.

D. Related Functions

N/A

E. Administrative Responsibilities

The incumbent is expected to perform all administrative tasks associated with work package performance, including monitoring of grants, contracts, and SBIR awards. In addition, he forges inter-disciplinary cooperation through the formation of intercompetency teams, develops and advocates work packages, and interacts with industry to foster technology transfer.

FACTOR II - SUPERVISION RECEIVED

The incumbent reports to the Head of the Sound Branch who provides broad administrative supervision.

A. Supervisory Relationship

Within the broad framework of the development of adaptive structures for application to aerospace, the incumbent is expected to identify and explore the most promising avenues of research. The researcher has total responsibility for generating project plans, enlisting the support of contributing organizations, and directing the research plan through to completion. The incumbent interprets research results and disseminates them to interested parties both within and outside LaRC.

B. Required Approvals

Within staffing and budget constraints imposed by the Program Manager and Supervisor, the incumbent has the freedom to formulate and execute the research plan. Technical supervision is minimal, and interactions with the supervisor reflect a reliance on the incumbent's judgment and recommendations. The incumbent is solely responsible for the technical direction of several research

C.. Delegated Authority

Within the incumbent's broad area of expertise, the researcher represents LaRC in technical matters and interactions with organizations both within and outside the Agency. Many of the research projects require the participation of other branches at the Center and may also involve the enlistment of support from outside organizations such as material suppliers, software developers, and end users such as aircraft companies. The incumbent negotiates such cooperation. Furthermore, the incumbent represents and describes research plans and findings with outside technical organizations. He disseminates research plans and findings directly to outside technical organizations. His recommendations are sometimes the basis for Center project level action. For example, his recommendations to the Morphing project manager resulted in revised Level 2 milestones and additional resources being allocated to the incumbent's team to accomplish those

FACTOR III - GUIDELINES AND ORIGINALITY

A. Existing Knowledge

In the area of adaptive structures there is a paucity of guidance available in the literature. Most efforts performed to date have been "cut and try"; there has been no systematic effort to develop and validate the appropriate design and analysis tools. The challenge is to fully understand the underlying physics and to then to develop useful engineering systems. For example, much information is available on the fundamental metallurgical characteristics of shape memory alloys, however it is insufficient for engineering analysis. Also, information regarding integration of SMAs into applications is sparse and ad hoc. The use of SMA's in a structural system thus requires significant advances in modeling capabilities, fabrication

B. Originality Required

Because of the lack of available guidance, a high degree of ingenuity is required, which the incumbent applies to this position, to enable the development of useful adaptive structures. This nascent technology area requires a high degree of creativity in developing methods and extending existing theories to model these unique structural systems. Unique fabrication techniques are required, as are complex test techniques to quantify the performance of such structures for concept and model validation. There is very little guidance available in any of these areas and the complexity of the material and structural systems demands a creative, coordinated effort in all areas to make research progress.

C. Demonstrated Originality

The researcher developed a new constitutive theory for SMA materials, and carried the theory through to produce a thermo mechanical analysis for studying the static and dynamic performance of plate-type structures. The researcher

research program to characterize these material systems and to fabricate subcomponent scale SMA hybrid composite structures for concept demonstration and analysis validation. The model and thermo mechanical analysis were validated using unique test techniques that allowed systematic assessment of the salient features of the analysis. This new modeling capability will enable structural analysts to design complex structures with advanced actuation schemes involving SMA, which has potential to lead to revolutionary

FACTOR IV - QUALIFICATIONS AND SCIENTIFIC CONTRIBUTIONS

An advanced degree in an appropriate engineering field and approximately 10 years experience in conducting research in adaptive structures and structural acoustics.

Provides technical leadership and consultation in the research field of adaptive structures for aerospace applications, an area of considerable importance to NASA. The incumbent leads a productive, multidisciplinary team of researchers from three Competencies by providing novel ideas and technical guidance. The incumbent has recognition among peers in government and industry and be known as a primary source of capability in his field. The incumbent has extensive experience with materials modeling, materials characterization, composite structural fabrication, advanced modeling of static and dynamic structural response involving material and geometric nonlinearities, static and dynamic structural test development, and advanced structural actuation concept development. Contributions to the field of adaptive structures from the incumbent are recognized through technical publications and professional society presentations, requests for technical assistance, and invitations to participate in

Employee Accomplishment Record

1. Name:

2. Education:

Ph.D., Engineering Mechanics, Georgia Institute, 2000 M.S., Engineering Mechanics, Virginia University, 1991 B.S., Mechanical Engineering, (Cum Laude) North Carolina University, 1987

3. Relevant Professional Training Received:

- Engineering and Designing Smart Structures, 3-day short course, sponsored by VPI&SU, 1999.
- Numerical Acoustics, 2-day short course, sponsored by Automated Analysis Corp., 2000.
- Modal Analysis: Theory and Applications, 3-day short course, sponsored by B&K, 1989.
- Hypersonic Vehicle Heat Transfer and Thermal Stress, 5-day

4. Significant Accomplishments

Supporting Documentation for each accomplishment

Each contribution should identify supporting documentation. A maximum of three evidences or exhibits may be used to document each contribution. It is not necessary to use the maximum number of allowed exhibits. It is more important to carefully select those most effective in supporting your contributions. Supporting documents must be referenced to the specific contribution. Full credit for a contribution cannot be given when the contribution is documented solely by the